

The claims defining the invention are as follows:

1. An antenna element comprising:
 - a ground plane;
 - a cylindrical helix having a uniform pitch, the cylindrical helix being disposed above the ground plane, the cylindrical helix being connectable to a communications apparatus at a first helix end, said first helix end being located near the ground plane; and
 - a lateral spiral substantially centred on the axis of the cylindrical helix, the spiral having a first end thereof connected to a second helix end, said second helix end being the opposite end of the cylindrical helix to the first helix end, said lateral spiral thereby terminating the antenna element.

2. An antenna element according to claim 1, wherein the axis of the cylindrical helix is substantially perpendicular to the ground plane.

3. An antenna element according to claim 1, wherein the lateral spiral lies in a flat plane that is substantially perpendicular to the axis of the helix.

4. An antenna element according to claim 1, further including a tapered
20 transmission line connected between the communications apparatus and the first end of
the cylindrical helix located near the ground plane.

5. An antenna element according to claim 1, wherein:
the cylindrical helix has (a) between 1.5 and 3.5 turns, (b) a pitch angle of
25 between 3 and 7 degrees, and (c) a circumference of between 0.9 and 1.15 wavelengths;
and

the lateral spiral has between 1 and 4 turns.

6. An antenna element according to claim 1, wherein:

the cylindrical helix has (a) between 3.5 and 40 turns, (b) a pitch angle of
5 between 10 and 14 degrees, and (c) a circumference of between 0.9 and 1.15
wavelengths; and

the lateral spiral has between 1 and 4 turns.

7. An antenna comprising:

10 a switched element feed network having an equipment feed-line for connection
to communication apparatus and a plurality of element feed-lines for connection to a like
plurality of cylindrical helix antenna elements according to claim 1, said switched
element feed network being adapted to connect a selected one of the cylindrical helix
antenna elements to the communication apparatus; and

15 said plurality of cylindrical helix antenna elements, said cylindrical helix antenna
elements being disposed above said ground plane, each said cylindrical helix antenna
element being individually connectable at a respective said first helix end located near the
ground plane to a respective element feed-line of the switched element feed network to
thereby connect to the communications apparatus.

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8. An antenna comprising:

a phased array feed network having an equipment feed-line for connection to
communication apparatus and a plurality of element feed-lines for connection to a like
plurality of cylindrical helix antenna elements according to claim 1, said phased array
25 feed network being adapted to collectively connect said plurality of cylindrical helix
antenna elements to the communication apparatus; and

5 said plurality of cylindrical helix antenna elements, said cylindrical helix antenna elements being disposed above said ground plane, each said cylindrical helix antenna element being individually connectable at a respective said first helix end located near the ground plane to a respective element feed-line of the phased array feed network to thereby connect to the communications apparatus.

9. An antenna according to claim 8, wherein the plurality of cylindrical helix antenna elements are arranged in a domino pattern.

10. 10. An antenna comprising:

a phased array feed network having an equipment feed-line for connection to communication apparatus and a plurality of element feed-lines for connection to a like plurality of cylindrical helix antenna elements, said phased array feed network being adapted to collectively connect said plurality of cylindrical helix antenna elements to the 15 communication apparatus; and

20 said plurality of cylindrical helix antenna elements arranged in a domino pattern, each said cylindrical helix antenna element comprising a ground plane and a cylindrical helix having a uniform pitch disposed above the ground plane, each said cylindrical helix antenna element being individually connectable at a respective first cylindrical helix end located near the ground plane to a respective element feed-line of the phased array feed network to thereby connect said cylindrical helix antenna element to the communications apparatus, wherein each said cylindrical helix antenna element further comprises a lateral spiral substantially centred on the axis of the cylindrical helix the lateral spiral having a 25 first end thereof connected to a second helix end being the opposite end of the cylindrical helix to the first helix end, said spiral thereby terminating the antenna.

11. An antenna according to claim 9 or claim 10, wherein:

the radial inter-element spacing between the centre antenna element and antenna elements at said corners of the domino pattern is between 0.5λ and 2.5λ at the frequency of operation of the antenna.

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12. An antenna having two antennas according to claim 9 or claim 10, wherein:

a centre cylindrical helix antenna element of a first of said two antennas is co-located with a centre cylindrical helix antenna element of a second of said two antennas; and

10 the first of said two antennas is laterally rotated with respect to the second of said two antennas, said lateral rotation being about a common axis of the co-located centre cylindrical helix antenna elements to thereby change inter-element spacing between antenna elements of said two antennas.

15 13. An antenna comprising:

a ground plane;

a plurality of cylindrical helices disposed above the ground plane, each said cylindrical helix being connectable, via a respective feed line of an associated phased array feed network to a communications apparatus, at a respective first helix end located 20 near the ground plane; and

a like plurality of lateral spirals, each substantially centred on the axis of the corresponding one of the plurality of cylindrical helices, said each lateral spiral having a first end thereof connected to a second helix end of the corresponding one of the plurality of helices, said second helix end being the opposite end of the cylindrical helix to the first 25 helix end, said lateral spiral thereby terminating the corresponding helix.

14. An antenna comprising:

a ground plane;

5 a plurality of cylindrical helices disposed above the ground plane, each said cylindrical helix being connectable, via a respective feed line of an associated switched element feed network to a communications apparatus, at a respective first helix end located near the ground plane; and

10 a like plurality of lateral spirals, each substantially centred on the axis of the corresponding one of the plurality of cylindrical helices, said each lateral spiral having a first end thereof connected to a second helix end of the corresponding one of the plurality of cylindrical helices, said lateral spiral thereby terminating the corresponding helix.

15. An antenna comprising:

15 a phased array feed network having an equipment feed-line for connection to communication apparatus and a plurality of element feed-lines for connection to a like plurality of cylindrical helix antenna elements, said phased array feed network being adapted to collectively connect said plurality of cylindrical helix antenna elements to the communication apparatus; and

20 said plurality of cylindrical helix antenna elements according to claim 1, said helix antenna elements being disposed above said ground plane and arranged in a rectangular grid pattern having a first spacing between rows of said rectangular grid pattern and a second spacing between columns of said rectangular grid pattern, each said cylindrical helix antenna element being individually connectable at a respective first helix end located near the ground plane to a respective element feed-line of the phased array feed network to thereby connect to the communications apparatus.

16. A method of impedance matching a cylindrical helix antenna element wherein the cylindrical helix antenna element comprises a ground plane, a cylindrical helix having a uniform pitch disposed above the ground plane, the cylindrical helix being connectable to a communications apparatus at a first helix end located near the ground plane, and a 5 lateral spiral substantially centred on the axis of the cylindrical helix the lateral spiral having a first end thereof connected to a second helix end, said second helix end being the opposite end of the cylindrical helix to the first helix end, said lateral spiral thereby terminating the cylindrical helix antenna, said method comprising the steps of:

10 adjusting a distance, from the ground plane, of the first helix end located near the ground plane to thereby adjust the impedance of a tapered transmission line formed between the ground plane and a first quarter turn of the cylindrical helix.